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Thunderstorms of November 2nd, 1930

By F. H. DIGHT, B.Sc.

On the morning of Sunday, November 2nd, 1930, most of southern England was startled by the sudden outbreak of a vigorous thunderstorm, accompanied by squally winds and a period of heavy rain. Rain had fallen steadily for several hours before and the character of the storm was such that the average person was justified in referring to it as "unusual weather for November." Generally, winter thunderstorms are quite short-lived, but on this occasion in London, and it would appear that the Metropolis experienced the full force of the storm, heavy thunder and lightning continued for the greater part of an hour.

The stormy opening of the month was the result of a complex series of disturbances passing northeastwards right across the country. At 6 p.m., November 1st, there were indications of a development westward of Ireland, and a few hours later a new fall of the barometer set in over the country. The intensity of the development can be gauged from the fact that at Blacksod Point the pressure fell 12mb. between 10 p.m. and 1 a.m., when a new low-pressure centre was located in that area. There was a corresponding fall of 8mb. at Valentia, and gales were blowing on the west coast of Ireland. By 7 a.m. more precise information of the structure of the new system was available. The new centre was then near Malin Head; the gale had extended

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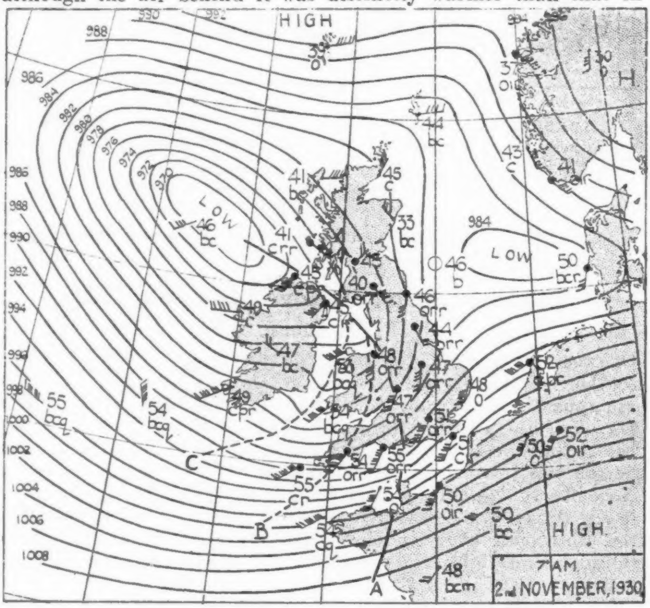
to the western English Channel, and the southerly winds were steadily increasing over England. It was apparent that the system had an appreciable warm sector and conditions were favourable for further development. The warm front had progressed roughly half-way across southern England, and it was raining steadily in advance of the warm front over practically the whole of England and southern Scotland. As is usual in depressions of this type the actual arrival of the warm front A (see map) is very indistinctly shown on the autographic records, although the air behind it was distinctly warmer than that in



front, as is obvious from the synoptic chart for 7 a.m. which is reproduced. This was followed in turn by two cold fronts B and C, the first and important one extending from Chester to near Ross-on-Wye to Plymouth, while the second was over the Irish Sea. From Malin Head to the Mersey the three fronts probably coalesced in a line of occlusion. Over Wales there was already at 7 a.m. the beginnings of a new development; this moved quickly northeast pulling the frontal system with it, and was located as an entirely new centre over Tynemouth at 1 p.m. The original centre then began to rotate in an anti-clockwise direction around the newly formed centre, until finally the two

coalesced to form a vigorous simple system over Denmark by 7 a.m. on November 3rd. As a result of these complex developments there was a prolonged and rapid fall of the barometer over the whole country which lasted for about 20 hours over the south and amounted to 28mb., of which a fall of 18mb. was accounted for by the formation and subsequent motion of the new centre over Wales.

It was with the passage of the first cold front on the morning of the 2nd that the violent phenomena to be described were associated. The second cold front passed over most of southern England during the early afternoon and was accompanied by a certain squalliness of the wind, local hail and thunder over a wide area, but on the whole with only slight precipitation. For a time there was a lull in the gale and strong winds. The passage of the final trough line associated with the swinging of the original centre followed much later, and was accompanied by further rain. There was a very definite veer of the wind which increased again to gale force over the whole of the western half of the country, and it was not until after the final trough had passed that the full force of a prolonged gale was experienced in this area. During the final blow which lasted several hours gust velocities exceeding 70 m.p.h. were registered in the west.

Reports from F. J. Parsons, Esq., Ross-on-Wye, from R. Gray, Esq., F.R.Met.Soc., Dorstone, and from F. Winter, Esq., Clevedon, show that the thunderstorms broke out in the Hereford-Somerset area about 7.30 a.m. with the passage of the first cold front, and were followed by a second outbreak with hail well within the hour, each storm being accompanied by periods of heavy rain. The storm line travelled eastwards, reaching London a little before 10.30 a.m., finally passing away to the North Sea about an hour later. The thunderstorm area seems to have been restricted; no reports of thunder were received from places along the south coast, while on the northern side Leafield (Oxon.) and Cardington (Beds.) both escaped, although in the narrow belt between these rough limits the storms appear to have been general, but as we shall see the squall phenomena, like the incidence of the heavy rain, were less restricted. The outstanding feature was the increasing vigour of the storm as it moved eastwards. At first, in the west, there were two separate thunderstorms, but by the time they reached London these had developed into one prolonged thunderstorm of approximately one hour's duration which was accompanied by heavy rain, and locally by hail. In London an observer noted 43 distinct claps of thunder in the hour. It is interesting to notice that the thunder was of the "booming and rattling" variety as the observer at Ross so aptly described it in his report, indicating that cloud to cloud lightning discharges predominated. Consequently

reports of lightning damage were remarkably few (see *The Times* of November 3rd), whereas during a similar type of storm on the night of December 6th, 1929, when cloud to earth discharges predominated, several people received fatal injuries and much structural damage was done.

The barograms from stations in the path of the storm are equally eloquent of the intensification of the phenomena, the record from Ross-on-Wye showing just a " kink " or temporary check in the continued fall during the passage of the front, whereas the records made in southeast England show a very sharp fall, followed by an almost instantaneous recovery, the amplitude being about 1mb. At Shoeburyness, where the storm reached its maximum intensity, the barogram shows a practically instantaneous drop and immediate recovery of 4·5mb. With the onset of the storm there was a rapid drop in temperature of from 4°F. to 7°F. over the whole of the south, but with the bright sunshine that accompanied the clearance, the temperature soon regained its former level.

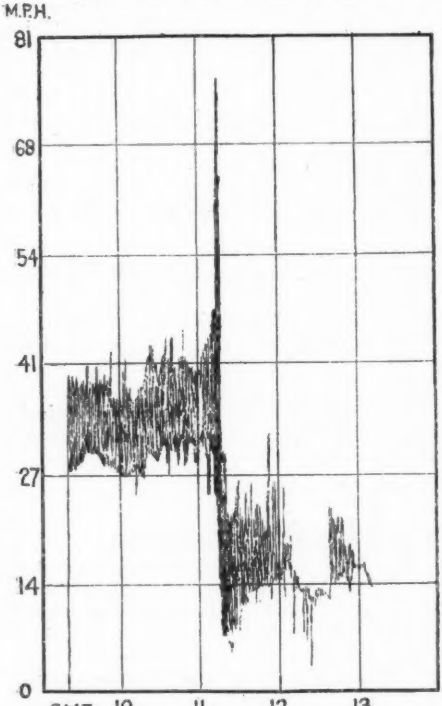
For a stormy November day the total rainfalls over the country during Saturday night and throughout Sunday were not excessive, the heaviest falls averaging between 0·7in. to 1in. over southern England. The more important feature concerns the measurements recorded during the thunderstorm, and here again the intensification over southeast England is very marked. The heavy rain accompanying the passage of the front was noted over a much wider area than the actual thunderstorms, but it was only over a relatively narrow belt perhaps 50 miles wide eastward from west London that markedly heavy falls occurred in relatively short periods at the height of the storm. The largest falls so far to hand under this heading are :—

(1) 13·5mm. (0·53in.) in 11 minutes. S. C. Russell, Esq., Worcester Park, Surrey.
(2) 8·4mm. (0·33in) in 15 minutes. L. C. Johnson, Esq., Streatham Common.
(3) 11·7mm. (0·46in.) in 30 minutes. E. E. Roper, Esq., F.R.Met.Soc., Hildenborough, Kent.
(4) 7mm. (0·28in.) in 18 minutes. Meteorological Office, Croydon Aerodrome.

Unfortunately a record of what was probably the heaviest fall was lost when the gauges at Shoeburyness were overturned during the storm. These figures do not represent the total fall associated with the passage of the first cold front, but only that of the period of heaviest rain, whereas on the other hand only 4 mm. (0·16in.) were measured at Cardington, Worthy Down and Felixstowe, and 8 mm. (0·31in.) at Lympne during the whole period of this phase.

In addition to the thunder and heavy rain, a further feature of the storm was the markedly squally character of the wind. In

its earlier stages the change from the warm sector air to the colder air behind it was marked by squally weather to which the reports from the west country testify, but again it was not until the front approached London that the squalls became exceptionally heavy. On the anemograms from Worthy Down (Winchester) and South Farnborough the initial stages of a definite squall can be picked out superimposed on the general squalliness which preceded the arrival of the front. By the time the front reached Croydon the final squall was much more developed and is distinctly shown on the anemogram at 10.15 a.m. as an additional feature of the storm. The maximum gusts recorded at some of the stations affected were: Calshot and Kew, 65 m.p.h.; Croydon, 55 m.p.h.; and Felixstowe, 53 m.p.h. But it was at Cardington and more particularly at Shoeburyness that the squall assumed unusual proportions. Prior to the arrival of the squall line at Cardington the average wind speed at 150 ft. above the ground was 37 m.p.h. with a maximum gust velocity of 57 m.p.h., but just before 10 a.m. there were a series of very violent gusts over a period of 10 minutes, during which a maximum velocity of 82 m.p.h. was registered. At Shoeburyness the squall was of an even more violent nature (a copy of the anemogram for this period is reproduced), and although the structure of the squall was similar to that at Cardington, the time interval during which the outstanding gusts were operative was reduced to something between one and five



COPY OF PORTION OF ANEMOGRAM.
SHOEBURYNESS, NOVEMBER 2ND, 1930.

minutes. Following a mean wind speed of 37 m.p.h. prior to the arrival of the squall, a close examination of the trace shows that there were four main gusts of 48, 76, 64 and 41 m.p.h., respectively. Accompanying the squall were many of the phenomena of a " miniature cyclone " or tornado—sudden darkness, very low clouds, thunder and lightning, a loud roaring sound, and torrential rain. Extensive damage was done to buildings, trees, huts and fences along a narrow straight track only 1,000 feet wide extending westsouthwest to eastnortheast across the town. A very careful and systematic examination of the damage, however, proves conclusively that the storm was a " straight blow " and not a tornado or a whirlwind. This conclusion is based on the fact that all the fallen trees, and all the tree tops which were snapped off, fell towards a northeast point. In addition none of the trees which were snapped off show signs of wrenching, nor the stumps signs of the heads having been twisted off. All the reports agree that the winds experienced were from between SW. and WSW.

Subsequently the storm seems to have lost much of its vigour, the last remnant of it being a gust of 71 m.p.h. at Lympne at 12.20 p.m.

The average east-west component of the surface velocity of the first cold front was about 40 m.p.h. which, when due allowance has been made for the fact that the gradient was southwesterly, is appreciably less than the geostrophic gradient of 70 m.p.h. would suggest, and it was probably due to this fact that the frontal phenomena became so much intensified as the front crossed southeast England.

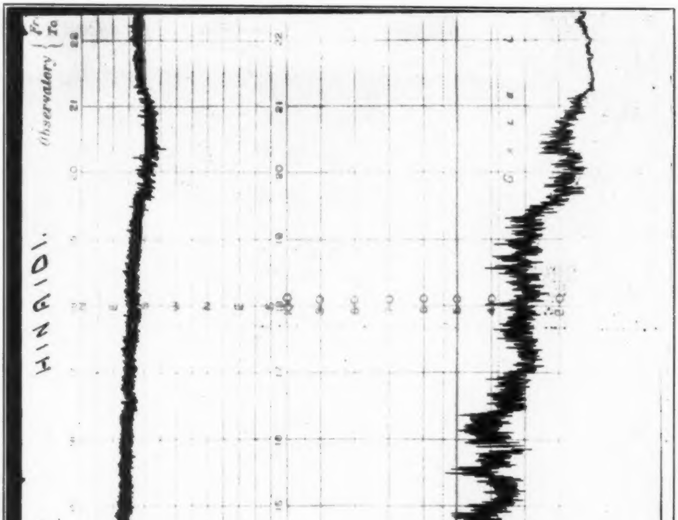
The writer is indebted to Mr. C. E. Britton, the Meteorological Officer at Shoeburyness, for details of the storm there, from whose report he has quoted extensively.

A Drawback of Leeside Exposures

The importance of Major Goldie's concluding remarks in the note entitled " A ' Record ' Gust," in the August number of the *Meteorological Magazine* (Vol. 65, p. 165), deserves close attention especially from those meteorologists who advise on aviation matters.

Major Goldie writes: " But at the same time the Glen Nevis gust and other general features of the Glen Nevis records demonstrate that however much the shelter of mountains may reduce the mean wind speed in the valleys the risk at least remains of the occurrence once in a while of a (sudden) gust of practically the same order of force as those experienced in the most exposed places."

These remarks can be illustrated, after allowance for the



ANEMOBIAGRAPH RECORDS, HINAIDI, JANUARY 6TH, 1930 (see p. 267).

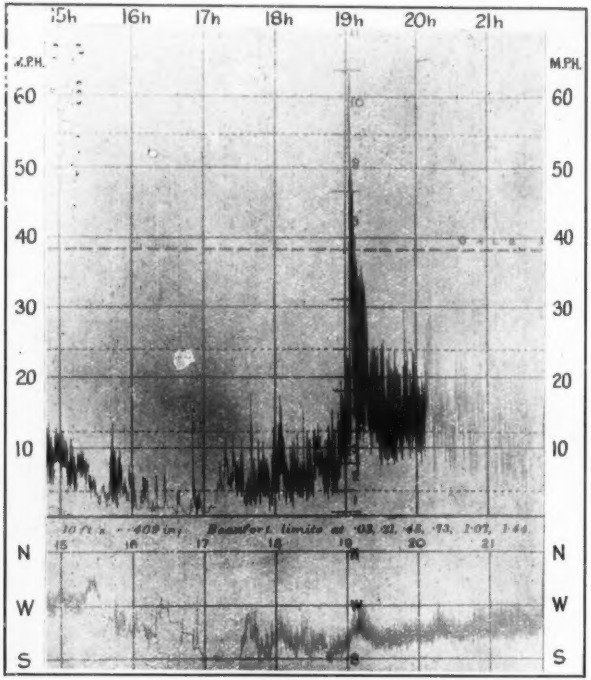


Fig. 1. Anemogram, Sealand, December 2nd, 1930.

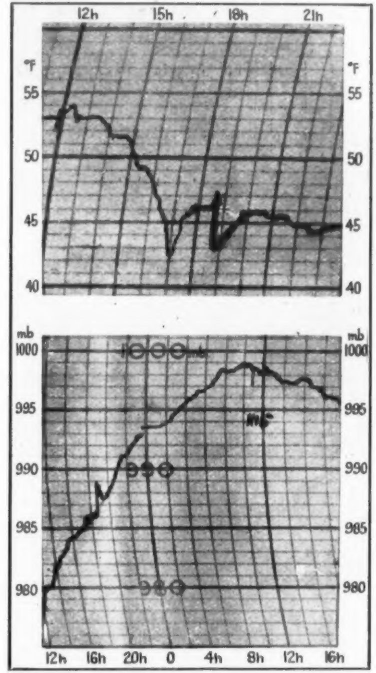


Fig. 2. Thermogram and Barogram, Sealand, December 2nd, 1930.

differences of exposure, from the anemometer records of Sealand (Cheshire), the site of which, between southsouthwest and west, is close to the Welsh mountains. The only amendment which one would like to suggest to this statement is the addition of the word "sudden" printed in the brackets above. It is to show the unexpected nature of these gusts, unexperienced at more open exposures, that a portion of the anemometer trace for December 2nd, 1929, is reproduced (Fig. 1). The gust occurred at 19h. 5m. G.M.T. From a scrutiny of pressure and temperature it exhibits all the characteristics of a line-squall. At the time the pressure distribution was favourable for such occurrences. There was a very deep depression southwest of Iceland (940mb.) with the run of the isobars, enclosing air of polar origin, over Ireland and England from the southwest. Four ships on the Atlantic reported air temperatures not below 46°, whilst reports of hail and thunderstorms indicated the general instability during the afternoon. There was an opening of the gradient over Wales and northwest England at 18h. that was not present on the 13h. map.

Although this sudden gust was undoubtedly in essence a line-squall, it is difficult to reconcile its abruptness except on grounds of configuration. The fact that sudden increases of such magnitude at open exposures in flat country are unknown, is one clue. The other clues are involved in sequences of temperature changes, that are difficult to explain concisely or perhaps very accurately.

The following explanation involves the assumption that the air at the high levels on the Welsh mountains cools more rapidly in similar conditions than the air in the plain below where this station stands. The cooling indicated by the drop of temperature (see Fig. 2) before 17h. is due to radiation though retarded somewhat by the weak sunshine up to 16h. consequent on a clear sky after 14h. (see Table 1). After 17h. the rise corresponds with the veer of the wind to SW which points to warming by descending air from the lower mountain levels in that quarter. In turn this descending air was followed by colder air presumably from the higher mountain levels, which despite its descent was eventually colder. It is significant that the minimum temperature at 17h., attributed to radiation, is 0·5° lower than the minimum temperature of the gust at 19h. 5m., suggesting that the replacing air has been somewhat warmed up—probably mainly through descent.

Moreover the continuity of the barograph trace (Fig. 3) negatives, as well as the stately isolation of the gust itself on the anemogram, any general, as distinct from particular, arrival of cold air attributable to the cyclonic circulation. Pressure was rising steadily and the incidence of the gust stands out on the barogram as an interruption of the steady rise then in progress. Such cascades can be only temporary if they are due to con-

figuration, and the records reflect this fact unmistakeably, *e.g.*, on the thermogram, after the gust the temperature comes back again to 46°, which was about the general temperature of the

TABLE I.—SQUALL AT 19H. 5M. G.M.T., DECEMBER 2ND, 1929.

Time	Weather	Wind	Temp.	Humidy.	Rain	Pressure	Remarks
			°F	%	mm.	mb.	
14h	cv.	W 16mph gusty	52·6	70	0·0	981·8	Sky cleared rapidly at 14h15m
15h	b.	W'N 10 mph	50·8	67	0·0	983·0	
16h	b.	SW'W 4 mph	48·0	66	0·0	984·3	
17h	b.	Calm	43·0	77	0·0	985·0	
18h	b.	SW 8 mph	45·7	72	0·0	986·4	lightning to WNW at 18h15m pressure tending to fall for about ¾h
19h	—	SSW 13 mph	46·0	70	0·0	986·0	
19h 5m	KQRb.	SW'W 68 mph	47—43	89	2·0	986–989	falling to 987·5mb. by 19h30m

Note:—Sunset 15h 57m G.M.T.

surface air as reported by the four ships for the 18h. weather map. Moreover the lightning is indicative of local instability—see for a precisely similar effect, though in relation to equatorial air exclusively, the early morning thunderstorms in the north Wales area of August 27th, 1930.

If this explanation be correct, the life history of this gust is as follows:—

(1) The arrival of dry air (see humidities, Table 1) which led to a clearing of the sky over mountain and plain in north Wales.

(2) A steady fall of temperature, particularly after sunset at 16h. through radiation.

(3) A rise of temperature in the plain after 17h. caused by katabatic air from the near and lower levels of the Welsh mountains (see anemogram).

(4) The arrival at 19h. of still colder air from the more remote and higher levels of the mountainous regions, causing, presumably through subsidence, abrupt increases both in pressure and wind speed and an abrupt fall of temperature.

(5) A return to the general cyclonic conditions after this mountain air supply had been exhausted.

J. J. SOMERVILLE.

Discussions at the Meteorological Office

November 10th.—*Illumination from sun and sky in the neighbourhood of Stockholm in* 1928. By T. E. Aurén. (Stockholm Stat. Hydro.-Meteor. Anst. Medd. 5, No. 4. 1930.) *Opener*—P. I. Mulholland, B.Sc.

A considerable amount of attention has been devoted in recent years to the photo-electric recording of the light from the sun and sky. The photo-electric cell of an alkali metal is the practical application of the discovery made by Hallwachs in 1888 that a body carrying a negative charge of electricity rapidly loses that charge when exposed to ultra-violet light. In 1889 Elster and Geitel showed that the alkali metals exhibited the same effect when exposed to light in the visible spectrum. J. J. Thomson and P. Lenard showed that the action of the light was to cause the emission of electrons, and later Lenard and others showed that the number of electrons emitted was proportional to the intensity of the incident light, this proportionality being found to hold over a wide range of light intensities. This paper describes the apparatus employed by the author in which photo-electric cells in combination with sensitive galvanometers have been used to record photographically the variations in the intensity of the illumination received from the sun and sky on a horizontal surface at Stocksund (Sweden). A brief account is given of the characteristics and behaviour of photo-electric cells and the precautions that must be taken to ensure trouble-free and consistent operation.

The records cover a period of one year, 1928, and included amongst the tabular matter are tables which give in arbitrary units the relative amounts of light-energy received daily on a horizontal surface, and in addition hourly values for the months June to September inclusive. For approximate calculations in the more familiar unit of radiation, the arbitrary unit of Dr. Aurén may be taken as roughly equivalent to 0·4 gm.-cal. per cm.^{2} per min. Using this approximate relation, the daily amount of light-energy recorded during 1928 varied from 290 gm.-cal. per cm.^{2} on June 26th to 1·7 gm.-cal. per cm.^{2} on December 11th. For the year the total light-energy recorded amounted, roughly, to 38 per cent of the total radiation as recorded by an Ångström pyranometer. The mean relative illumination during 1928, or the ratio of the total illumination recorded to the illumination that would have been recorded had the sky been always clear, amounted to 65 per cent.

In the discussion it was pointed out that for the proper interpretation of the records it was desirable to have the spectral sensitivity curves of the cells employed, since it has been found that the response to light of a given wave-length differs for different cells of the same metal, and this fact makes the comparison of records from different places at present rather

uncertain. The paper is a valuable indication of what is being done to extend our at present meagre knowledge of a subject of great importance in researches in human and plant physiology and climatological questions in general.

The subject for discussion for the next meeting will be:—

January 12th, 1931.—*Explosions for research purposes. Second communication. Results from October* 1*st*, 1926, *to March* 31*st*, 1929, *in Germany.* By H. Hergesell and P. Duckert (Lindenberg, Arbeit, Aeron. Obs. 16, 1929, D. pp. 1-32) (in German). *Opener*—Dr. F. J. W. Whipple, F.Inst.P.

Royal Meteorological Society

The opening meeting of this Society for the present session was held on Wednesday, November 19th, in the Society's Rooms, at 49, Cromwell Road, South Kensington, Mr. R. G. K. Lempfert, M.A., F.Inst.P., President, in the Chair.

J. Edmund Clark, I. D. Margary, R. Marshall and C. J. P. Cave.—Report on the Phenological Observations in the British Isles, December, 1928, *to November*, 1929.

In a year of extreme conditions the abnormalities largely cancelled out giving an " average year ": the cold of January and February compensated by the warmth of March and September: drought in spring by deluge in November. But the brilliant March sunshine, half as much again as usual, was more than match for the dullness of January, February and August. Winter migrants, such as fieldfares and redwings, fled from usual haunts to avoid the cold, but reappeared as welcome guests in south Ireland and southwest England. Sharp spells of cold in April, May and June neutralised the alarming number of queen wasps, so that few workers troubled the autumn fruits. In the table of flowering dates, all are late in England and Wales, though decreasingly so; from 17 to 14 days for the hazel and coltsfoot in February, to 1 and 2 days for the devil's bit, scabious and ivy in early August and late September. That the determining factor was cold of continental type spreading exceptionally in proportion to propinquity is well shown by the district values. England, E., for the seven early spring flowers, hazel to hawthorn, was 13 days late (hazel, 26); S.E., 12; Midlands, 10. But these plants were actually early in Ireland and Scotland, N., and only two days late in Scotland, W. Our earliest bird record, the song of the thrush, and the honey bee date for insects tell the same tale: the latter 12 days late in England, E., 4 early in Scotland, W. The exceptional nature of the March warmth and sunshine is as usual best illustrated by the insects with their quick response to weather conditions. On the average the queen wasp appears two days after blackthorn blooms; in 1929, ten

days earlier. It was over a month early in Scotland, W., and the orange tip butterfly nearly as much in Scotland, E. The year's results in farm and garden as to quantity and quality showed a small balance on the credit side, due chiefly to the superb September. But to drought in the southeast was due a shortage of hay and straw, while in the far north, late comparatively in its harvest time, the October deluge played sad havoc.

A. V. Williamson, M.A., and K. G. T. Clark, B.A.—The Variability of the Annual Rainfall of India.

In this paper variability is defined as the percentage departure—irrespective of sign—from normal annual rainfall which has occurred at a given station in half the years of the period, 1890-1923. The importance of phenomenally extreme years is recognised, but not considered, the object being to portray characteristic, not exceptional, conditions. After a brief résumé of the geographical distribution of rainfall over India at different seasons two generalisations are submitted and illustrated, namely (i) the lower the rainfall the greater variability tends to be, (ii) rainfall is less reliable when it is characteristically concentrated than when it is well distributed in time. The paper then proceeds to discuss the map which accompanies it, and which shows India divided into zones by means of " lines of equal-variability." The desert to the northwest and the semi-arid core of the Deccan reveal the greatest variability, the former in particular. The west coast south of Bombay, Assam, Bengal and Orissa, are areas of abundant and reliable rainfall. Despite a good average rainfall, Gujarar and the central portion of the east coast of Peninsular India show an uncertainty rivalling that of the Central Deccan, and considerably in excess of Mysore and adjacent areas with only a very moderate but well-distributed precipitation. In conclusion, attention is paid to a recent paper by E. Biel, of Vienna (Die Veränderlichkeit der Jahressumme des Niederschlags auf der Erde); the authors compare their own results with those presented for India in that publication.

Asche Moe (Stavanger).—The North Sea as a link between climate, plant growth, and migration of birds, in the British Isles and in Norway.

Correspondence

Cyclones and Anticyclones

In his interesting letter in your October number Sir Napier Shaw suggests that the production of velocity in the atmosphere is a single problem and that pressure-difference arises as a consequence of the creation of velocity. (Horizontal velocity is implied, though not explicitly stated.) I venture, with some

diffidence, to question the correctness of the "single problem" assumption.

Is it not reasonable, nay, probable, that the problem of the general motion of the atmosphere is quite different from the problem of a tropical revolving storm? Sir Napier would have us believe that the atmosphere does not move because it is pushed but pushes because it is moved. Does not the atmosphere do both? If I may use an analogy, a motor-car moves primarily because it is pushed, but it may execute gyrations because it is moving, even when the primary push is a thing of the past.

So in the atmosphere, I conceive a push, or pressure-difference, between equator and pole as the cause, and not the consequence, of the general motion; because such pressure-differences would exist even if every square metre of earth carried a column of air enclosed within vertical walls which prevented horizontal motion altogether. For the god responsible for these pressure-differences see *Paradise Lost*, Book IV, line 37—no doubt, like all wise gods, he has his helpers or intermediaries.

A familiar example, where motion is the cause and not the consequence of pressure-difference, occurs with a general north-west current sweeping across France and the Alps: a depression appears on the Gulf of Genoa: the pressure-difference would not arise in this case if every metre-square column of air were enclosed within vertical walls which prevented horizontal motion —the difference arises because the atmospheric motor-car meets an obstacle on the road and skids badly.

E. GOLD.

*8, Hurst Close, Bigwood Road, N.W.*11. *October* 19*th*, 1930.

Line-Squall, November 2nd, 1930*

I should like to give an account, as briefly as possible of a line-squall which occurred here yesterday, November 2nd, 1930.

When drizzle was falling from low-driving nimbus clouds with a squally SW. wind, a sudden peal of thunder occurred to the west. There was no sign of a storm, but a few minutes after the thunder occurred, which was about 10h. 15m. (G.M.T.), a long line of cloud appeared to the northwest low near the horizon. This line moved rapidly higher into the sky and was to be seen stretching from the north through northwest to west or west-southwest.

The line itself was merely an abrupt cessation of the low nimbus cloud who had previously covered the sky. Below the rather ragged edge of the line a uniform sheet of whitish-grey covered the sky. By 10h. 30m. (G.M.T.) the storm suddenly burst with a strong squally wind and torrents of rain. The actual squall only lasted five or more minutes, and one flash of

* See p. 249.

lightning and peal of thunder occurred during its passage. After it was over, rain fell steadily from a uniform sky and the thunder became fainter to north or northeast, but later another flash of lightning occurred to southeast followed by a peal of thunder. One or two minutes later a very vivid purple flash was immediately succeeded by one of the most terrific crashes we have had this year. A house was struck by lightning in Oakhill Road, Surbiton, and I should not be at all surprised if this was the flash that caused the damage.

After a few more flashes and rumbles to southeast the storm passed.

The total rainfall collected during the storm was just over half an inch. One interesting feature I noticed during the storm was the very light wind which prevailed when the main thunderstorm was in operation. Pressure had fallen rather rapidly to 983mb. when the squall broke and the only interruption in the trace on the barogram was a temporary cessation of the fall. Temperature had risen to 56°F. in the " screen " before the squall, but fell 3° briskly on its arrival and two more later on; not such a large fall as has occurred here on many other occasions of squalls of far less intensity, so the squall here did not seem to have been caused by a burst through of polar air as I had suspected when it first came in sight.

K. G. Willis.

Lasham, Effingham Road, Surbiton, Surrey. November 3rd, 1930.

Damage by Lightning at Walpole Highway

Mr. C. Dann, of " Lyndhurst," Queens Road, Wisbech, sends us particulars of the damage to a house at Walpole Highway, about five miles from Wisbech, on the evening of October 25th. There was only a single flash of lightning, at 5.10 p.m., but this sufficed completely to wreck one side of the house. A chimney stack was felled, and more than half the roof was uncovered, slates flying in all directions. Some of the bricks were carried into an adjoining field, to a distance of 100 yards, and other bricks and slates were carried completely across the road. The plaster of the ceilings of an upstairs bedroom and of the sitting room below was brought down, the fireplaces of both rooms were blown out, as was the kitchen sink. The force of the explosion was evidently very great, and it is interesting to note that the son of one of the occupants saw what he thought was a fireball passing through the hall into the kitchen. Fortunately there was no loss of life.

Pen Reservoir With Delayed Ink Feed. Rounded Baxendell Pen

The delayed ink feed similar to that suggested by Mr. P. R.

Zealley* has been successfully used here for a number of years; in addition to the wick, a small light reservoir is soldered on to the pen holder, there being no elbow; the wick can then pass into the reservoir, where the ink level should not be above the point of contact between pen and chart. This method is used on the pressure-tube anemograph and Baxendell instruments satisfactorily.

Some time ago difficulty was caused on the Baxendell instrument when a northerly wind of moderate strength allowed the pen to dig into the chart as it crossed the overlap, usually resulting in a broken pen and damaged record. This occurred in damp weather and was overcome in the following manner. A " J " type of pen had its point filed off so that a curved contact with the chart was made. It is rather important in rounding the pen to shape it symmetrically either side of the pen slit, making the curve 1·0mm. radius. This allows the slit to make a point contact with the chart, and maintains the ink flow. Over-inking should be avoided. This pen, used with a reservoir and wick, was adopted here six months ago, and has not, except for inking, needed attention since.

W. SELWAY.

Meteorological Research Station, Leafield, Oxon. July 25th, 1930.

Weather of a Hundred Years Ago

Mr. Richard Cooke, of The Croft, Detling, Maidstone, has sent us the following extracts from " Old Days in Country Places. Notes from Diaries by Two Authors," by Cecil Palmer.

These diaries describe two villages—one quite in the north of Herefordshire and the other in the south of the same county—some 100 years ago.

Page 41. " ' I heard Langorse a-roaring,' said Mrs. Evans—Mrs. Evans lives on the edge of the common, and has lived there for fifty years. ' I heard it plain, and we'll have tempestuous weather I do know.'

" For the country people hereabouts have a belief that the sound of the wind heard here on a still day is Langorse Lakes, thirty miles away among the Brecon Hills, tempest-tossed, and that the sound surely foretells a storm. Some of them however call the sound the ' Hiren ' as I have said, and the learned may be able to tell me what spirit of the waste or weald this may be.

" Do the sheep know that wild foreboding voice? . . . . . but I do know that one night—a night with a soft west wind blowing gently and all things moist with thaw—a flock of Davy's mountain-bred sheep were down at the fold-gate, patiently waiting to be let in. ' What do ail the things,' said Davy, who always looked at the sky and ' folded ' his sheep if snow was imminent. He saw no sign of snow now and doubted the ' dumb ' creatures

* See *Meteorological Magazine*, 65, 1930, p. 115.

were wiser than he was. However he brought them in: and lo! he awoke the next morning to see a white world, and a fierce swirling north-west wind drifting the snow up the mountain gullies and bringing destruction to flocks less sagacious than his own." March 7th (unfortunately no date of the year given anywhere, but about a hundred years ago).

Page 164, same book, quotes from "A Glossary of Provincial Words used in Herefordshire, published by Murray in 1839"—

a "dabbledy" day for a wet day.

a "glemmy" day for a day of sunshine and cloud, a gleamy day.

Ancient Hindu Meteorology

Monsoon Prognostications.—The famous astronomer Varaha-Mihira is believed to have lived in the 5th century A.D. In his work entitled *Brihat-Samhita* (*i.e.*, the Big Compilation) he summarises meteorological knowledge handed down from the time of the *Upanishads.* The verses of the *Samhita* are very interesting. There is evidence to show that raingauges were known in ancient India and that more or less accurate observations of halos, twilights, thunder, lightning, winds, etc., were made and utilised for weather prognostications.

In Chapter 21 of this book the astronomer sets out the auspicious signs which herald a good monsoon. These are summarised below against months which correspond approximately to the Hindu lunar months in the *Samhita.*

October-November:	A red glow on the horizon in the morning and evening, clouds and halos; not severe cold.
November-December:	A red glow on the horizon in the morning and evening, clouds and halos; not too much snow.
December-January:	Strong wind, dim sun and moon, great cold, thick clouds at sunrise and sunset.
January-February:	Violent dry gales, thick clouds with smooth bases, broken halos, copper red sun.
February-March:	Clouds accompanied with wind and rain.
March-April:	Lightning, thunder, wind and rain.

These inferences are presumably based on observations at a number of places in the Indo-Gangetic plain.

According to Varaha-Mihira cloud observations for the forecasting of the subsequent monsoon rainfall should commence by the second fortnight of October, *i.e.*, the beginning of winter. The impregnation of the atmosphere with moisture begins in winter and the "rain-embryos" formed during each of the above months produce rain after 195 days. If most favourable conditions prevail in each of these months, the number of rainy

days would be 8, 6, 16, 24, 20 and 3 in May, June, July, August, September and October respectively, *i.e.*, the wettest monsoon should consist of 77 rainy days.

It is interesting to note that in the very wet monsoon of 1917 there were 5, 6, 12, 15, 13 and 5 rainy days in each of the months May to October over the fertile plains of northwest India, giving a total of 56 rainy days in the season. The resemblance between the two sets of rainy days, ancient and modern, is remarkable. In ancient India a " rainy day " was defined to be a day on which sufficient rain fell to leave impressions on the soil or water-drops on the tips of grass blades. (Vide *Brihat-Samhita*, Chapter 23, Verse 3.) This amount is certainly less than 0·1in. of rain adopted by the Indian Meteorological Department as their lower limit of a rainy day.

Varaha-Mihira also states that if there is too much rain in the winter the subsequent monsoon degenerates into drizzles or, in other words, excessive rain in the winter is prejudicial to the subsequent monsoon rainfall over northwest India. It is a curious coincidence that some of the correlation coefficients in M. V. Unakar's recent paper (*vide* Sc. Note, Vol. 1, No. 6, Ind. Met. Dept.) should support this generalisation.

S. N. SEN.

Meteorological Office, Poona. August 29th, 1929.

In Dr. Sen's note above, one of the symptoms favourable for rainfall in July is " strong wind " in December-January. It is interesting to note that the strength of westerly upper winds in a layer of 3 to 7 Km. over Agra (14 years) bears a correlation coefficient of + 0·55 (probable error ± 0·13) with the subsequent July rainfall over northwest India. It should be noted that between December-January and July there is an interval of 195 days referred to in the note.

The symptoms for each month given in the note are of the nature of partial correlations as unfavourable conditions in any one month may vitiate the favourable influences of other months. A correlation coefficient of 0·55 is therefore significant enough to warrant further examination.

M. V. UNAKAR.

Meteorological Office, Poona. August 31st, 1929.

Range of Visibility in a Fog

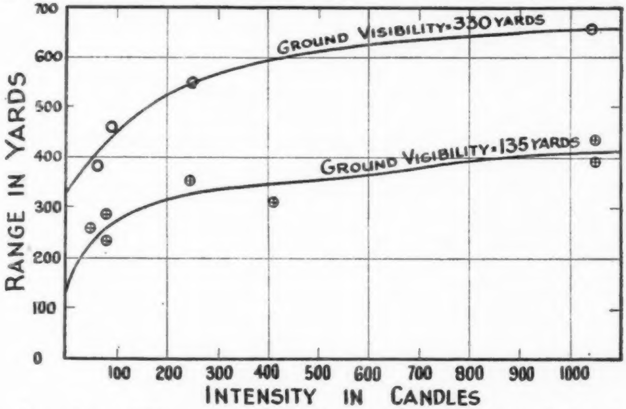
With reference to Col. Gold's note on the above subject,* some experimental work has been done on this subject by the electrical research department of the Royal Aircraft Establishment (Report No. E.E. 347).

A light source was set up on a level straight road during foggy weather and the ranges corresponding to various inten-

*See *Meteorological Magazine*, 65, 1930, p. 11.

sities of illumination were measured for two different values 135 and 330 yards of ground horizontal visibility in daylight. A copy of the graph obtained is appended.

It will be noticed that the range increases rapidly at first with increase in light intensity, but that above about 1,000 candle power further increases only produce relatively small changes in range. With the latter source of light the daylight visibility is doubled in the case of fog of 330 yards, but is trebled in the case of fog of 135 yards' daylight visibility. A source of 100 candle power is sufficient to double the visibility in the latter case. Col. Gold's observations in Kingsway with



a fog about 175 yards' visibility and a doubling of this by the light from a lamp would indicate an intensity of about 150-200 candles for this lamp. The incandescent gas lamp in the Finchley Road would probably be more of the order of 60 candles' intensity and would account for the doubling of visibility in a denser fog. In general, the denser the fog the less the intensity of illumination required to double the ordinary daylight visibility.

The observations are insufficient for the deduction of an equation connecting range and intensity, but for any given illumination the graphs appear to indicate that the range gradually approaches the ground visibility as the latter increases, and theoretically there should be a certain visibility above which the difference is small. This point is raised in connexion with the routine estimation of visibility as between day and night. At night, when observations of lights at fixed distances are often employed, there is a tendency to overestimate visibility on account of the factor of range. (The range of a light may be taken as being greater at night than in

daylight.) As a consequence it might be expected during winter that estimates of visibility at 18h. during night time would be higher than those at 16h. in daylight. Observations during the current winter do not indicate this, the effect due to range probably being, at least above visibility F (1,000-1,200 yards), well inside the limits within which each letter lies. On most nights, however, one does get the feeling that visibility has increased with the advent of darkness.

The results of further tests by the Royal Aircraft Establishment to determine the ranges at which lights of different intensities and colours can be seen at night in conditions of bad visibility are awaited with interest.

W. H. Bigg.

South Farnborough. March 7th, 1930.

NOTES AND QUERIES

The Climate and Weather of the Middle Eocene in Western America

For a period of several million years a great mountain basin in Colorado and Utah was continuously occupied by a large lake, which for part of the time at least had no outlet. In the bottom of this lake, year after year, thin layers of sediment were deposited, until they aggregated 2,000ft. in thickness and formed a record which for the completeness and detail of the insight it gives into the conditions of formation, must be almost unparalleled. These deposits are known as the Green River formation, and Mr. Wilmot H. Bradley has now set out the results of his investigation into the climatic conditions of the time in a paper of great interest.*

The deposits consist of an enormous number of extremely thin laminæ, arranged in pairs, alternately brown and black. The author shows conclusively that each pair of layers, a fraction of a millimetre in thickness, represents the accumulation of one year, the brown layer, which consists mainly of mineral flakes and crystalline calcite, being probably formed in early summer, and the black layer, mainly organic, in late summer.

The lake, termed Gosiute Lake, occupied 12,300 square miles, and resulted from the drainage of 21,900 square miles. From several lines of argument, which give reasonably concordant results, the author concludes that the annual rainfall was between 30 and 43in., and approximately balanced the transpiration and evaporation. The rain probably fell in a long mild winter, while summer was dry and hot—there are heat cracks on the floor of the lake filled in by subsequent deposits. The mean annual temperature was about 65°F. For comparison it may be

*The varves and climate of the Green River Epoch *Washington, U.S. Geological Survey. Professional Paper*, 158-*E*, 1929.

remarked that at present the mean annual rainfall is about 10in. and the temperature at a height of 1,000ft. 58°F. The weather was normally quiet, for the material is so fine that it could not have been deposited so regularly in a shallow lake disturbed by storms.

The most interesting feature of the report concerns the rhythmic variations in the thickness of the annual layers. Three well-marked periodicities are found, having lengths of a little less than 12 years, 50 years and 21,630 years. The 12-year periodicity is plausibly attributed to the sunspot cycle of just over 11 years; it ranges from 7 to 18 years in much the same way as does the sunspot cycle. It is suggested by analogy with Lake Victoria that at times of sunspot minima Lake Gosiute was abnormally low and that for this reason as well as because of the higher air temperature associated with sunspot minima, it was abnormally warm, increasing the amount of both crystalline calcite and organic matter. The cycle of 50 years is predominantly one of rainfall and evaporation, for it is represented by layers of moulds of salt crystals.

The cycle of 21,630 years (from the 16 repetitions given, the length has a probable error of under 100 years) is shown by a repeated change from oil shale to marlstone, and the author suggests that a series of years with long cool winters and short hot summers would favour the formation of oil shales, poor in calcite but rich organically, while years with a more uniform temperature would favour the calcite and produce marlstones. This is just the succession which would result from the cycle of the precession of the equinoxes, which has a length of about 21,000 years but is highly variable. It seems probable that the author has discovered a real example of the effect of astronomical variations in changing climate.

C. E. P. Brooks.

Notes on a Gale in Iraq

In his meteorological report for the month of January, 1930, Flight-Lt. W. J. Seward, who is in charge of the Meteorological Section, Air H.Q., Iraq Command, gave some notes on a storm which occurred at Hinaidi between January 5th and 8th. It was remarked by Col. Gold that the occurrence of a wind of an average velocity of 48 m.p.h. for an hour with a maximum gust of only 61 m.p.h. was sufficiently unusual to demand notice, and permission has been obtained for the reproduction of part of the Hinaidi anemobiagraph trace for January 6th. (See Plate facing p. 254.) In the notes Flight-Lt. Seward states: "This storm undoubtedly occurred as the result of a large depression moving eastward through the country to the southwest of Iraq. On

nearing Iraq (on the afternoon of the 5th) the northerly portion of this depression took the form of an inverted V. In districts northeast of a line Rutbah—Abu-Ghar the winds freshened and blew from between ENE. and ESE. accompanied by showers. On the 6th the northern extremity of the inverted V had moved more northeast and rain was falling in most districts before dawn. At Hinaidi, at 6h. 30m., G.M.T., the wind on the surface was blowing from ESE. at an average velocity of 35 m.p.h. The wind gradually veered more SE. whilst the average velocity increased to 48 m.p.h. between 10h. and 11h., G.M.T. The maximum gust of SE. to E. 61 m.p.h. occurred at 10h. 47m., G.M.T., from 11h. to 12h. intermittent slight rain occurred. At 22h., G.M.T., on the 6th moderate rain commenced, and intermittent rain and drizzle occurred until 2h. 35m., G.M.T., on the 8th.

On the 7th the inverted V was detached from the southern portion of the depression. . . . This detached portion appeared to amalgamate with another low pressure system situated over eastern Syria; the combined depression then moved eastward into Persia on the 8th.

In the winter months depressions frequently move from the Cyprus region eastward across northern Iraq, Persia and Afghanistan when they give useful rains. These depressions, in crossing the Syrian desert, at times detach secondaries which pursue a more southerly track to southwest Persia.

Information for the full investigation of the depression in question is not available, but a few remarks may be of interest. The synoptic map for 8h. on the 6th given by the Egyptian Daily Weather Report shows a small depression centred near Beirut and another small depression indicated near Rutbah, about 250 miles eastward from Baghdad. Reports from R.A.F. meteorological stations show that at Rutbah the wind changed from ENE. force 3 (Beaufort) to W., force 6 between 6h. and 13h. G.M.T. on the 6th while a thunderstorm occurred from 6h. 30m. to 6h. 45m. At Diwaniyah, about 100 miles southsoutheast of Baghdad a moist wind from the direction of the Persian Gulf seems to have been replaced by a drier wind from a more southerly direction between 13h. G.M.T. on 6th and 2h. on 7th. Observations from Hinaidi are not available at the time of writing, but it seems probable that the air at Hinaidi on the 6th came originally from the Persian Gulf and travelled 340 miles up the low lying valley; the flat country and perhaps a slight convergence of flow due to the contours of the land near Baghdad may have accounted for the absence of 'land wind'* characteristics from the anemogram. Details of the upper air conditions at the time are not known. In the Persian Gulf itself, the alternation of strong southeasters (known locally as

* See *Goldie, London* *Q.J.R. Meteor. Soc.* 51, 1925, p. 357.
Johnson, ,, ,, ,, 54, 1928, p. 179.

kaus) and northwesters (shamal) is a well-known feature of the winter season. It would be interesting to know if these names are in general use in Iraq also."

Meteorological-Aerological Station at Cape Guardafui

The following notification has been received from the National Geodetic and Geophysical Committee of Italy:—

" Attention has been repeatedly drawn to the advisability of establishing an aerological station at Cape Guardafui for the investigation of the upper air. It is now possible to announce that the said station is already fully active and meteorological and aerological observations have been carried out three times daily (at 7h., 13h. and 18h. G.M.T.) since January 23rd, 1930. The station is equipped with a barograph, thermograph, hygrograph and all the necessary apparatus for daily pilot balloon soundings, in accordance with the procedure at other similar Italian stations.

The daily recording of the observations is superintended by two Petty Officers of the Royal Italian Navy who have been attached to the Forecast Office for some days in order to follow a special course of instruction.

As the station has been established particularly with a view to transmitting the results of the meteorological and aerological observations to shipping and aircraft in that neighbourhood, the observations are broadcast three times daily at 7h. 30m., 13h. 30m. and 18h. 30m., coded in accordance with the international regulations.

The ' F. Crespi ' wireless transmitting set has been set up at Cape Guardafui. The observation records are submitted periodically to the Forecast Office, which provides for their working up and subsequent publication.

F. Eredia."

Padua. 1930.

Review

Data of Heavy Rainfall over Short Periods in India. Ind. Met. Mem. Calcutta. Vol. XXV, Part III, pp. 109-143. 1929.

The title of the paper illustrates the difference in the climate of the British Isles and India, for instead of containing details of intense rains for a few minutes or at most a few hours, the information set out is that of the heaviest daily falls together with the amounts recorded on the preceding and following days. Only falls exceeding 10 inches are included, and many falls of more than 24 inches in a day are given. In the British Isles thunderstorm rains of an inch an hour are unusual, but in India this intensity is frequently maintained during monsoon rains for a day and more. The largest daily fall quoted is 38·33 inches (but as

this is given as 35·33 inches in the preceding line, possibly the latter value only should be adapted, especially as this is still the largest in the table). The most remarkable run of wet days is that from June 14th to 16th, 1914, when 80·15 inches was recorded at Cherrapunji, Welsh Mission House. This is as much as falls in London during three years, and only about 3 per cent. of the total area of the British Isles receives this amount on the average in a year. The bulk of the entries occur, of course, in May, June, July and August. There are a number in September and October, but only one or two entries for January, March, April, November and December.

The information given in this memoir supplements that given in Volume XXI, Part III, up to 1911. The present memoir gives additional data up to the end of 1926, in a concise form for reference. Some 1,500 daily amounts exceeding 10 inches are quoted for the 15 years under review. During the whole history of British Rainfall no actual measurement of 10 inches of rain for a day has been made, although there are three occasions when this amount was probably exceeded, *viz.*, on November 12th, 1897, at The Stye, in the English Lake District; on July 3rd, 1892, at Langtoft, in East Yorkshire; and on August 18th, 1924, at Cannington, in Somersetshire.

J. GLASSPOOLE.

Obituary

Mr. Henry Alfred Rogers.—The announcement of the sudden death by heart failure of Mr. Henry Rogers on November 17th at his residence at 31, Fernbank Road, Redland, Bristol, will be received with great regret over a wide circle. In his early work as a commercial traveller, he learnt to read the signs of the sky and became a well-known local weather forecaster. His retirement through ill-health gave him leisure to read widely and to develop his hobby, and he wrote numerous articles in the Bristol press as well as contributing frequently to the correspondence columns of the *Meteorological Magazine*, while since 1920 he has observed rainfall regularly. As late as October, 1930, an interesting contribution on the subject of "Red Sunrises and Sunsets" appeared in our pages. Although in his 85th year, he was surprisingly active, playing bowls regularly, and one who saw him on the occasion of the British Association meeting at Bristol can fully endorse the description given to him as a "Grand Old Gentleman." Mr. Rogers was greatly delighted when the Bristol Meteorological Observatory was opened with an old pupil of his, Mr. G. H. Brown, as observer, and the station was approved by the Meteorological Office. We thank Mr. Brown for sending these details and join with him in extending our sympathy to Mrs. Rogers in her bereavement.

News in Brief

Mr. J. A. Webster, C.B., D.S.O., has been appointed to the Meteorological Committee in place of Sir Henry McAnally, C.B., who has retired.

Mr. C. N. Knight has been appointed to the Meteorological Committee in place of Mr. L. V. Meadowcroft, who has retired.

Professor Dr. Wilhelm Schmidt has been appointed Director of the Central Institute of Meteorology and Geodynamics, Vienna, and Professor of physics of the earth at the University, Vienna, in succession to Hofrat Professor Dr. F. M. Exner, who died in February, 1930.

The Weather of November, 1930

November, 1930, was generally a wet month, mild in the south of the British Isles but cold in the north and west. The month opened with mild rainy conditions accompanied by mist and fog. On the morning of the 2nd, however, a violent squall line associated with a deepening depression crossed southern England, and some heavy thunderstorms were reported.* Rainy conditions continued in the southwest until the 6th and snow and sleet occurred in Scotland on the 3rd and 4th, but generally the weather became brighter and colder as a ridge of high pressure developed over the country. Sharp ground frosts occurred on the 4th, 5th and 6th, a minimum temperature on the ground of 12°F. being reported from Dumfries and Burnley on the 5th. On the 7th there was a change to westerly winds, strong in the north, with mild rainy weather; 2·17in. fell at Borrowdale (Cumberland), 1·26in. at Mount Callan (Co. Clare) on the 7th, and 1·10in. at Oban on the 8th. This was succeeded by a period of mainly dry anticyclonic weather in the south and east until the 13th, but the northwest came under the influence of the Icelandic depression, and though there was not much rain, gales and strong winds prevailed on many days. Records of sunshine were good on the 4th, 6th and 11th, while on the 14th places on the south coast again enjoyed over 8 hrs. of sunshine. Maxima reached 60°F. at places as far apart as York, Nottingham and Ross-on-Wye on the 9th, while 62°F. was registered at Waterford on that day. Behind a trough of low pressure, associated with a deep depression over Scandinavia which gave rain in Scotland on the 14th and general rain on the 15th, an anticyclone moved southeast across the country to the continent, bringing cold weather to all districts. During the squally weather accompanying the change on the night of the 14th a gust of 78 m.p.h. was registered at Birmingham and one of 74 m.p.h. at Scilly. Snow occurred in many parts of Scotland and the English Midlands, and sharp frost prevailed at night especially on the night of the 16th-17th, when a minimum

* See page 249.

of 17°F. occurred at Marlborough and of 18°F. at Rhayader and Eskdalemuir, while temperature on the ground fell to 7°F. at Rhayader and 9°F. at Burnley. Day temperatures were correspondingly low with local fog. At Renfrew the maximum did not rise above 29°F. on the 17th. In northern England the 16th was a sunny day. A mainly rainy period followed from the 18th to 26th with depressions moving northeastwards across the country; heavy rain fell in several districts on most days, except the 23rd which was sunny except in the southwest. The falls included 2·71in. at Fofanny (Co. Down) and 1·83in. at Holne (Devon) on the 23rd, 1·70in. at Llyn Fawr (Glamorgan) on the 24th and 1·65in. at Douglas on the 18th. Gales were frequently reported on various parts of the coast, and particularly in the English Channel. Snow occurred generally in Scotland on the 22nd, and there were local thunderstorms on the 21st, 22nd and 26th in England. From tht 27th to 30th improved conditions with a considerable amount of sunshine were enjoyed in the north and west, but in the south there was still much rain at times. The distribution of bright sunshine was as follows:—

	Total (hrs.)	Diff. from normal (hrs.)		Total (hrs.)	Diff. from normal (hrs).
Eskdalemuir	60	+ 13	Liverpool	61	+ 2
Aberdeen	79	+ 24	Ross-on-Wye	71	+ 8
Dublin	75	+ 4	Falmouth	73	− 3
Birr Castle	57	+ 7	Gorleston	74	+12
Valentia	63	− 2	Kew	60	+ 8

Pressure was above normal over the Mediterranean, the greater part of the North Atlantic, Labrador, the whole of the United States, British Columbia, and Alaska, the greatest excesses being about 5mb. in Tripoli, south of Nova Scotia and at Barrow (Alaska). Pressure was below normal over Europe north of 45°N., including the British Isles and neighbouring seas, Iceland, Spitsbergen, Canada and western Siberia, the greatest deficit being nearly 12mb. in the Svealand and Norrland provinces of Sweden. Temperature was generally between 2°F. and 4°F. above normal over western Europe and 12°F. above normal at Spitsbergen, while rainfall was in excess generally over western Europe. In central Sweden the rainfall varied from 40 per cent to 80 per cent above normal, but fell to 20 per cent below normal in southeast and northwest Sweden.

Owing to the heavy rains the Seine was in flood at the beginning of the month, but had ceased to rise in Paris on the 11th. A landslide due to heavy rain in the neighbourhood occurred in the St. Jean quarter of Lyons on the 13th. Some minor landslides occurred on the Kilchenstock, in the valley of

the Linth, Canton Glarus on the 21st and the following days, and the geologists reported that the Kilchenstock was then moving more than an inch a day. Its collapse may be hastened by the heavy rains. A landslide caused by heavy rains in the Loire districts occurred between Oudon and Anciens on the 21st. A violent storm accompanied by torrential rain swept over northern, central and western France on the 22nd, and many low-lying stretches of country and of the towns were flooded. The Seine continued to rise until about the 26th, then fell considerably, only to rise suddenly again on the 29th. Persistent rains caused floods in Belgium about the 22nd. The Rhine and its tributaries were also rising rapidly on the same day owing to storms, heavy rain and the quick melting of the snow. The storm in Germany on the 23rd did considerable damage, and many people were injured by a storm in Vienna on the 22nd. A strong Föhn wind was experienced in Switzerland on the 22nd and 23rd, causing the temperature to rise to 65°F. in the plains.

A typhoon of exceptional violence struck the islands of Pulo Condere, Indo-China on the 6th. Many people were killed and a number of fishing boats were sunk off the coast near Saignon. A cyclone struck the island of Kyaukpu, near Akyab, on the 10th, doing much damage, while a town on the island of Ramree was wrecked by a cyclone the same day.

During the first half of the month, temperature was below normal in the United States except in the Mountain Regions and along the Pacific coast, while rainfall was generally slight in the western regions and moderate in the eastern. During the later part of the month temperature was generally above normal especially in the northeastern regions, and rainfall was heavy locally at first, slight later. Many people were killed at Bethany, Oklahoma, on the 19th, when the town was struck by a tornado.

Severe gales were experienced on the North Atlantic early in the month.

The special message from Brazil states that rainfall was scarce in the northern and southern regions, being 0·39in. and 0·75in. below normal respectively, while it was plentiful in the central regions with 1·50in. above normal. Three anticyclones passed across the country but conditions were generally disturbed. The northeastern regions were suffering from lack of rainfall, but elsewhere the crops (except cocoa) were generally in good condition. At Rio de Janeiro pressure was 1·3mb. above normal and temperature 1·4°F. below normal.

Rainfall, November, 1930.—General Distribution

England and Wales	152	per cent of the average 1881-1915.
Scotland	134	
Ireland	110	
British Isles	138	

Rainfall: November, 1930: England and Wales

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Lond	Camden Square	4·27	181	*Leics*	Belvoir Castle	2·94	132
Sur	Reigate, Alvington	5·05	162	*Rut*	Ridlington	2·92	...
Kent	Tenterden, Ashenden	5·34	177	*Linc*	Boston, Skirbeck	3·06	153
,,	Folkestone, Boro. San.	5·28	...	,,	Cranwell Aerodrome	3·09	165
,,	Margate, Cliftonville	3·63	151	,,	Skegness, Marine Gdns	3·35	155
,,	Sevenoaks, Speldhurst	5·22	...	,,	Louth, Westgate	3·65	142
Sus	Patching Farm	5·92	166	,,	Brigg, Wrawby St.	3·10	...
,,	Brighton, Old Steyne	5·50	172	*Notts*	Worksop, Hodsock	3·08	157
,,	Heathfield, Barklye	6·33	171	*Derby*	Derby, L. M. & S. Rly.	2·91	135
Hants	Ventnor, Roy. Nat. Hos.	5·11	159	,,	Buxton, Devon Hos.	5·11	109
,,	Fordingbridge, Oaklnds	5·76	169	*Ches*	Runcorn, Weston Pt.	3·75	135
,,	Ovington Rectory	5·72	172	,,	Nantwich, Dorfold Hall	3·13	...
,,	Sherborne St. John	4·70	165	*Lancs*	Manchester, Whit. Pk.	4·34	164
Berks	Wellington College	4·31	169	,,	Stonyhurst College	6·02	133
,,	Newbury, Greenham	4·64	166	,,	Southport, Hesketh Pk	4·81	153
Herts	Welwyn Garden City	4·36	...	,,	Lancaster, Strathspey	4·82	...
Bucks	High Wycombe	4·84	194	*Yorks*	Wath-upon-Dearne	2·65	130
Oxf	Oxford, Mag. College	4·20	190	,,	Bradford, Lister Pk.	4·48	153
Nor	Pitsford, Sedgebrook	3·19	145	,,	Oughtershaw Hall	9·46	...
,,	Oundle	2·59	...	,,	Wetherby, Ribston H.	4·23	181
Beds	Woburn, Crawley Mill	3·75	167	,,	Hull, Pearson Park	3·54	162
Cam	Cambridge, Bot. Gdns.	3·88	201	,,	Holme-on-Spalding	2·86	...
Essex	Chelmsford, County Lab	3·69	164	,,	West Witton, Ivy Ho.	3·78	...
,,	Lexden Hill House	3·37	...	,,	Felixkirk, Mt. St. John	3·62	148
Suff	Hawkedon Rectory	4·30	189	,,	Pickering, Hungate	4·29	...
,,	Haughley House	3·33	...	,,	Scarborough	4·43	179
Norf	Norwich, Eaton	3·87	151	,,	Middlesbrough	3·10	146
,,	Wells, Holkham Hall	3·82	177	,,	Baldersdale, Hury Res.	4·61	...
,,	Little Dunham	4·00	154	*Durh*	Ushaw College	3·63	143
Wilts	Devizes, Highclere	4·32	162	*Nor*	Newcastle, Town Moor	2·71	112
,,	Bishops Cannings	4·89	171	,,	Bellingham, Highgreen	4·11	...
Dor	Evershot, Melbury Ho.	7·13	167	,,	Lilburn Tower Gdns.	4·29	...
,,	Creech Grange	6·83	...	*Cumb*	Geltsdale	3·92	...
,,	Shaftesbury, Abbey Ho.	4·66	144	,,	Carlisle, Scaleby Hall	3·83	128
Devon	Plymouth, The Hoe	6·86	188	,,	Borrowdale, Seathwaite	14·25	105
,,	Polapit Tamar	6·15	145	,,	Borrowdale, Rosthwaite	13·37	...
,,	Ashburton, Druid Ho.	9·06	160	,,	Keswick, High Hill	6·73	...
,,	Cullompton	6·11	178	*Glam*	Cardiff, Ely P. Stn.	4·94	118
,,	Sidmouth, Sidmount	4·80	154	,,	Treherbert, Tynywaun	11·92	...
	Filleigh, Castle Hill	5·75	...	*Carm*	Carmarthen Friary	5·56	112
	Barnstable, N. Dev. Ath.	3·92	100		Llanwrda	7·21	122
Corn	Redruth, Trewirgie	8·20	168	*Pemb*	Haverfordwest, School	5·22	104
,,	Penzance, Morrab Gdn.	6·53	142	*Card*	Aberystwyth	5·03	..
,,	St. Austell, Trevarna	7·98	162	,,	Cardigan, County Sch.	4·97	...
Soms	Chewton Mendip	6·16	144	*Brec*	Crickhowell, Talymaes	5·40	...
,,	Long Ashton	4·82	...	*Rad*	Birm W. W. Tyrmynydd	8·14	122
,,	Street, Millfield	3·63	...	*Mont*	Lake Vyrnwy	9·77	175
Glos.	Cirencester, Gwynfa	3·72	125	*Denb*	Llangynhafal	3·92	...
Here	Ross, Birchlea	3·67	145	*Mer*	Dolgelly, Bryntirion	8·97	145
,,	Ledbury, Underdown	3·49	143	*Carn*	Llandudno	4·30	139
Salop	Church Stretton	3·92	133	,,	Snowdon, L. Llydaw 9	22·80	...
,,	Shifnal, Hatton Grange	3·14	131	*Ang*	Holyhead, Salt Island	4·68	113
Worc	Ombersley, Holt Lock	2·63	115	,,	Lligwy	3·98	...
,,	Blockley	4·05	...	*Isle of Man*			
War	Farnborough	...	...		Douglas, Boro' Cem.	6·24	132
,,	Birminghm, Edgbaston	3·28	138	*Guernsey*			
Leics	Thornton Reservoir	3·55	157		St. PeterP't. GrangeRd.	10·32	246

Rainfall: November, 1930: Scotland and Ireland

Co.	Station	In.	Per-cent. of Av.	Co.	Station	In.	Per-cent. of Av.
Wigt.	Pt. William, Monreith	5·19	...	*Suth* .	Loch More, Achfary ...	13·61	159
,, .	New Luce School......	5·58	...	*Caith* .	Wick......	3·85	125
Kirk .	Carsphairn, Shiel......	10·17	...	*Ork* .	Pomona, Deerness......	4·26	108
Dumf.	Dumfries, Crichton, R.I	4·09	118	*Shet* .	Lerwick	4·82	113
,, .	Eskdalemuir Obs.	7·12	123	*Cork* .	Caheragh Rectory......	7·52	...
Roxb .	Branxholm	4·40	133	,, .	Dunmanway Rectory...	7·37	119
Selk .	Ettrick Manse......	5·61	...	,, .	Ballinacurra......	4·06	101
Peeb .	West Linton......	5·20	...	,, .	Glanmire, Lota Lo......	5·27	123
Berk .	Marchmont House......	4·38	146	*Kerry.*	Valentia Obsy......	6·35	116
Hadd.	North Berwick Res......	3·07	137	,, .	Gearahameen......	10·60	...
Midl .	Edinburgh, Roy. Obs.	3·81	177	,, .	Killarney Asylum......	5·65	101
Ayr .	Kilmarnock, Agric. C.	4·87	129	,, .	Darrynane Abbey......	7·12	140
,, .	Girvan, Pinmore..	6·46	121	*Wat* .	Waterford, Brook Lo...	4·14	109
Renf .	Glasgow, Queen's Pk. .	4·46	120	*Tip* .	Nenagh, Cas. Lough...	4·05	101
,, .	Greenock, Prospect H.	8·84	138	,, .	Roscrea, Timoney Park	2·82	...
Bute .	Rothesay, Ardencraig.	7·21	142	,, .	Cashel, Ballinamona...	3·74	107
,, .	Dougarie Lodge......	5·91	...	*Lim* .	Foynes, Coolnanes......	3·95	97
Arg .	Ardgour House	14·36	...	,, .	Castleconnel Rec......	4·17	...
,, .	Manse of Glenorchy...	13·32	...	*Clare* .	Inagh, Mount Callan...	6·47	...
,, .	Oban......	6·46	...	,, .	Broadford, Hurdlest'n.	4·29	...
,, .	Poltalloch	7·96	141	*Wexf.*	Gorey, Courtown Ho...	3·91	112
,, .	Inveraray Castle...	11·19	132	*Kilk* .	Kilkenny Castle......	3·42	111
,, .	Islay, Eallabus......	9·89	183	*Wic* .	Rathnew, Clonmannon	3·73	...
,, .	Mull, Benmore......	15·90	...	*Carl* .	Hacketstown Rectory..	4·48	115
,, .	Tiree	5·65	...	*Leix* .	Blandsfort House......	3·41	102
Kinr .	Loch Leven Sluice......	4·10	114	,, .	Mountmellick......	3·89	...
Perth .	Loch Dhu......	8·65	100	*Off'ly* .	Birr Castle......	2·94	95
,, .	Balquhidder, Stronvar	6·62	...	*Kild'r.*	Monasterevin	2·82	...
,, .	Crieff, Strathearn Hyd.	3·80	88	*Dubl* .	Dublin, FitzWm. Sq...	2·34	87
,, .	Blair Castle Gardens...	4·30	122	,, .	Balbriggan, Ardgillan.	3·64	126
,, .	Glen Bruar, Bruar Ldg.	6·02	...	*Me'th* .	Beauparc, St. Cloud...	3·82	...
Angus.	Kettins School.	4·42	158	,, .	Kells, Headfort......	4·03	118
,, .	Dundee, E. Necropolis	3·69	151	*W.M.*	Moate, Coolatore......	3·85	...
,, .	Pearsie House......	4·04	...	,, .	Mullingar, Belvedere..	4·43	130
,, .	Montrose, Sunnyside...	3·57	135	*Long* .	Castle Forbes Gdns......	4·05	112
Aber .	Braemar, Bank...	3·69	96	*Gal* .	Ballynahinch Castle...	7·83	131
,, .	Logie Coldstone Sch....	3·82	124	,, .	Galway, Grammar Sch.	4·66	...
,, .	Aberdeen, King's Coll.	3·53	120	*Mayo* .	Mallaranny......	7·78	...
,, .	Fyvie Castle......	5·08	...	,, .	Westport House......	5·09	104
Moray.	Gordon Castle......	4·42	153	,, .	Delphi Lodge......	10·73	...
,, .	Grantown-on-Spey......	3·99	133	*Sligo* .	Markree Obsy......	4·58	110
Nairn.	Nairn, Delnies	4·96	210	*Cav'n* .	Belturbet, Cloverhill...	2·66	85
Inv .	Kingussie, The Birches	4·14	...	*Ferm* .	Enniskillen, Portora...	3·31	...
,, .	Loch Quoich, Loan......	18·21	...	*Arm* .	Armagh Obsy......	3·05	107
,, .	Glenquoich......	17·86	147	*Down* .	Fofanny Reservoir......	8·83	...
,, .	Inverness, Culduthel R.	4·43	...	,, .	Seaforde......	4·16	110
,, .	Arisaig, Faire-na-Squir	7·27	...	,, .	Donaghadee, C. Stn...	3·73	122
,, .	Fort William......	9·39	...	,, .	Banbridge, Milltown...	2·91	...
,, .	Skye, Dunvegan......	6·86	...	*Antr* .	Belfast, Cavehill Rd...	4·77	...
R & C.	Alness, Ardross Cas ...	7·20	179	,, .	Glenarm Castle......	6·92	...
,, .	Ullapool	8·44	...	,, .	Ballymena, Harryville	3·82	94
,, .	Torridon, Bendamph...	7·89	85	*Lon* .	Londonderry, Creggan	4·50	110
,, .	Achnashellach......	9·91	...	*Tyr* .	Donaghmore......	4·92	...
,, .	Stornoway......	5·35	92	,, .	Omagh, Edenfel......	4·40	116
Suth .	Lairg......	6·60	...	*Don* .	Malin Head......	4·74	...
,, .	Tongue	7·41	161	,, .	Dunfanaghy......	4·90	...
,, .	Melvich......	9·88	...	,, .	Killybegs, Rockmount.	5·49	87

Climatological Table for the British Empire, June, 1930.

STATIONS	PRESSURE: Mean of Day M.S.L.	PRESSURE: Diff. from Normal	TEMPERATURE: Absolute Max.	TEMPERATURE: Absolute Min.	TEMPERATURE: Mean Values Max.	TEMPERATURE: Mean Values Min.	TEMPERATURE: Mean Values ½ max. and min.	TEMPERATURE: Mean Values Diff. from Normal	TEMPERATURE: Mean Wet Bulb	Relative Humidity.	Mean Cloud Am'nt	PRECIPITATION: Am'nt	PRECIPITATION: Diff. from Normal	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Percentage of possible
	mb.	mb.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	%	0—10	in.	in.			
London, Kew Obsy.	1016·2	— 0·5	81	44	79·5	53·2	61·9	+ 2·7	55·1	80	6·3	1·31	— 0·84	6	7·6	46
Gibraltar	1015·0	— 2·4	85	53	76·0	59·7	67·9	— 2·6	60·0	87	4·9	5·86	+ 5·38	8	..	..
Malta	1014·6	— 1·0	88	65	79·4	67·6	73·5	+ 0·8	67·1	74	4·1	0·02	— 0·07	1	11·3	78
St. Helena	1016·6	+ 0·9	..	54	..	56·3	..	..	57·2	93	8·9	3·57	— 0·50	20	..	..
Sierra Leone	1013·9	+ 1·9	88	67	84·9	72·3	78·6	— 1·7	75·5	84	6·5	10·12	— 9·92	25	..	..
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1017·6	+ 0·1	79	46	70·3	51·8	61·1	— 1·8	..	78	4·5	0·26	— 0·22	5	..	..
Salisbury, Rhodesia	1019·3	0·0	76	36	67·7	43·7	55·7	— 1·2	48·3	51	2·8	0·04	— 0·01	2	7·7	69
Cape Town	1022·4	+ 2·3	83	36	67·1	48·0	57·5	+ 1·8	48·6	85	4·4	0·65	— 3·85	8	..	..
Johannesburg	1024·9	+ 0·8	64	33	58·8	39·6	49·2	— 1·5	38·8	48	1·9	0·01	— 0·13	1	8·3	79
Mauritius	1017·2	— 1·8	79	56	75·7	62·8	69·3	— 0·1	65·7	69	4·8	3·72	+ 0·92	13	7·1	65
Bloemfontein	..	..	..	..	..	..	..	..	..	..	..	0·14	— 0·33	..	..	..
Calcutta, Alipore Obsy.	1000·8	+ 1·1	101	73	93·2	79·3	86·3	+ 1·2	80·1	85	7·8	8·59	— 3·31	13*	..	..
Bombay	1003·7	— 0·3	94	74	88·8	78·8	83·8	— 0·1	78·2	81	5·9	26·71	+ 6·84	17*	..	..
Madras	1004·0	+ 0·2	106	74	96·4	79·2	87·8	— 2·3	76·0	68	7·9	3·10	+ 1·21	5*	..	..
Colombo, Ceylon	1009·3	+ 0·6	87	71	84·9	75·7	80·3	— 1·4	77·5	83	8·9	13·34	+ 5·37	25	4·2	34
Hongkong	1007·6	+ 1·5	91	69	86·7	78·3	82·5	+ 1·1	78·1	78	7·9	12·25	— 3·84	20	7·2	53
Sandakan	..	..	91	73	88·4	75·0	81·7	0·0	77·2	83	..	7·27	— 0·03	13	..	..
Sydney, N.S.W.	1021·4	+ 3·6	69	41	61·7	51·3	56·5	+ 1·9	52·8	86	7·3	11·81	+ 7·04	21	2·7	31
Melbourne	1025·2	+ 6·7	68	34	58·2	43·2	50·7	+ 0·3	47·0	74	6·2	1·88	— 0·21	10	3·7	39
Adelaide	1025·0	+ 6·0	70	37	62·5	45·1	53·8	+ 0·3	47·2	67	6·2	1·11	— 2·04	8	5·7	59
Perth, W. Australia	1013·6	— 4·3	71	48	66·3	54·0	60·1	+ 3·3	55·6	79	7·3	11·35	+ 4·43	22	3·5	35
Coolgardie	1017·4	— 1·7	79	38	65·6	47·1	56·3	+ 3·6	51·3	75	7·0	1·37	+ 0·14	9	..	..
Brisbane	1019·3	+ 1·2	74	41	67·8	54·1	60·9	+ 0·7	56·2	75	6·4	7·58	+ 4·95	16	5·5	53
Hobart, Tasmania	1024·1	+ 9·8	63	32	52·2	39·9	46·1	— 0·7	41·4	77	5·5	1·17	— 1·03	12	4·3	47
Wellington, N.Z.	1017·9	+ 3·0	59	35	52·6	41·5	47·1	— 2·3	44·4	77	5·2	2·85	— 1·92	13	5·0	54
Suva, Fiji	1014·5	+ 0·9	85	61	78·6	68·1	73·3	— 1·6	68·8	75	6·2	5·09	— 1·06	15	5·0	45
Apia, Samoa	1010·5	— 1·1	87	69	83·9	73·6	78·8	+ 1·0	75·5	75	5·0	3·46	— 1·70	8	6·8	60
Kingston, Jamaica	1013·5	— 0·3	92	71	88·4	73·8	81·1	— 0·2	72·8	78	5·2	0·82	— 3·28	6	7·0	53
Grenada, W.I.	1013·5	+ 0·4	89	71	86·3	72·9	79·6	+ 0·7	73·9	77	7·5	11·85	+ 3·53	28	..	..
Toronto	1012·3	— 2·0	91	46	76·9	56·9	66·9	+ 4·3	59·8	73	4·9	2·43	— 0·33	10	8·9	58
Winnipeg	1009·6	— 2·9	87	37	74·8	53·3	64·1	+ 1·9	54·1	77	4·7	2·55	— 0·71	11	9·1	56
St. John, N.B.	1014·3	+ 0·3	87	37	67·0	50·9	58·9	+ 2·4	54·8	85	8·0	2·46	— 0·81	10	6·7	43
Victoria, B.C.	1017·2	+ 0·3	82	45	63·9	49·4	56·7	— 0·3	52·3	75	6·1	0·66	— 0·27	6	9·1	57

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Victoria, B.C.	1017·2	+ 0·3	82	45	63·9	49·4	56·7	— 0·3	52·3	75	6·1	0·66	— 0·27	6	9·1	57

* For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.